



**ITS: The Nation's Spectrum and Communications Lab**

*Realizing the full potential of telecommunications to drive a new era of innovation, development, and productivity*

**ITS** Institute for Telecommunication Sciences

# 2023 5G Challenge Webinar

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Julie Kub

Jeremy Glenn

Margaret Pinson

[jkub@ntia.gov](mailto:jkub@ntia.gov)

[jglenn@ntia.gov](mailto:jglenn@ntia.gov)

[mpinson@ntia.gov](mailto:mpinson@ntia.gov)

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# 2023 5G Challenge: Advanced Interoperability – NTIA and DoD Collaborative Effort



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Boulder, Colorado • [its.ntia.gov](http://its.ntia.gov)



# Agenda

- ▶ Eligibility
- ▶ Challenge structure
- ▶ CableLabs, the 2023 5G Challenge host lab
- ▶ Important dates, documents, and details
- ▶ Questions



# Eligibility



## Eligibility Requirements

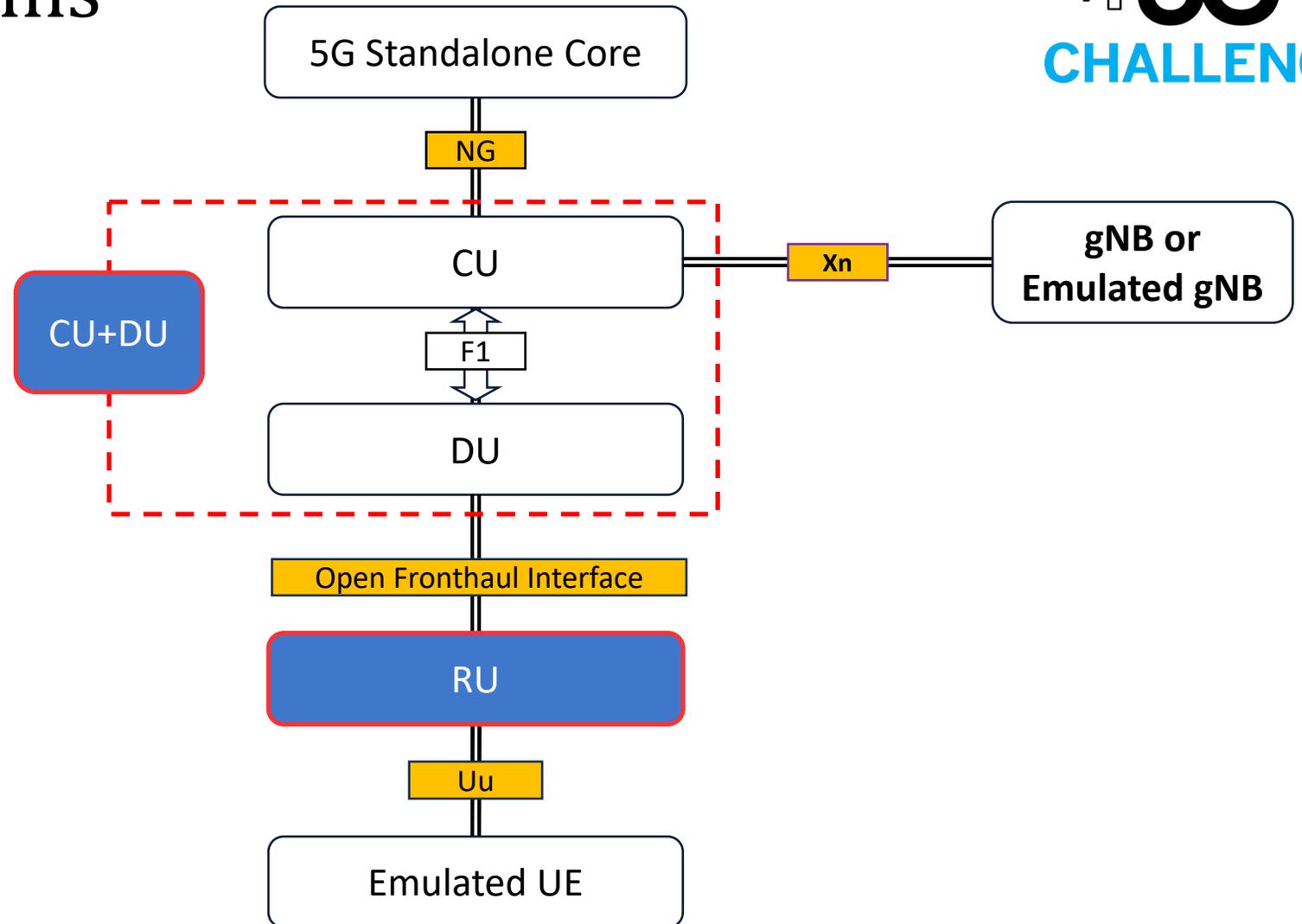
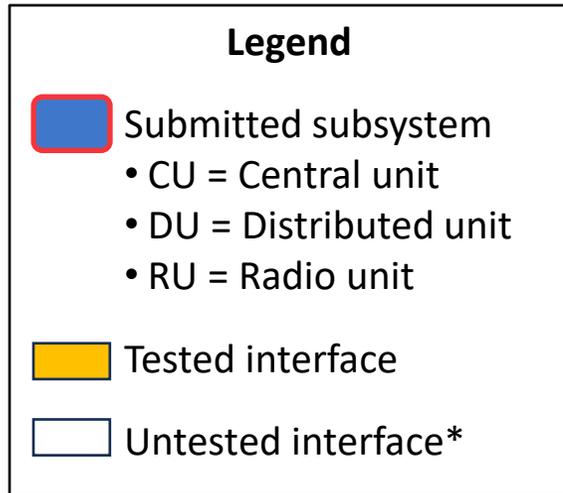
- ▶ Two options
- ▶ Single or multiple organizations
  - Organization must have primary place of business in the U.S. or its territories
- ▶ Individual or group of individuals (“team”)
  - Individual or team leader must be:
    - At least age 18
    - U.S. citizen or permanent U.S. resident

## Ineligible

- ▶ Companies barred from U.S. contracting
- ▶ Government employees
- ▶ Government contractors
- ▶ Persons supporting or advising the 2023 5G Challenge

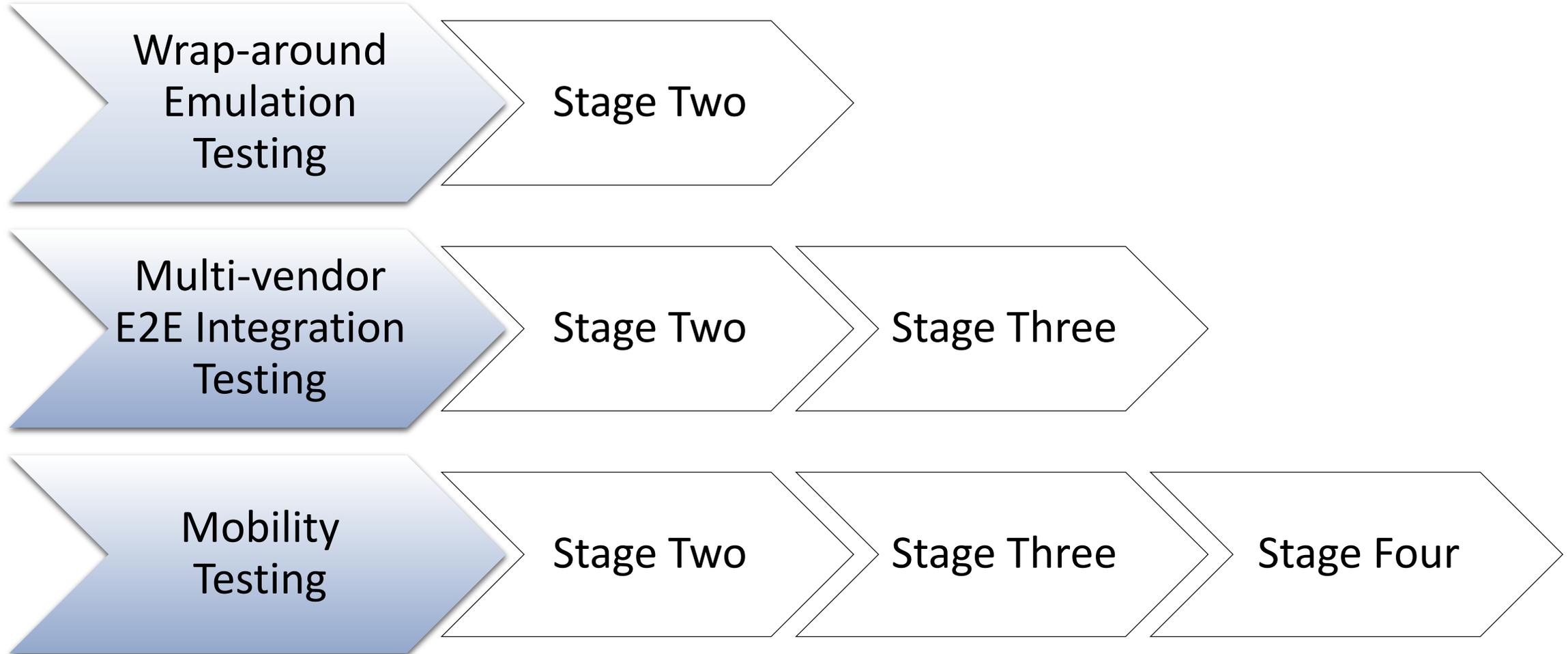


# Tested 5G Subsystems and Interfaces

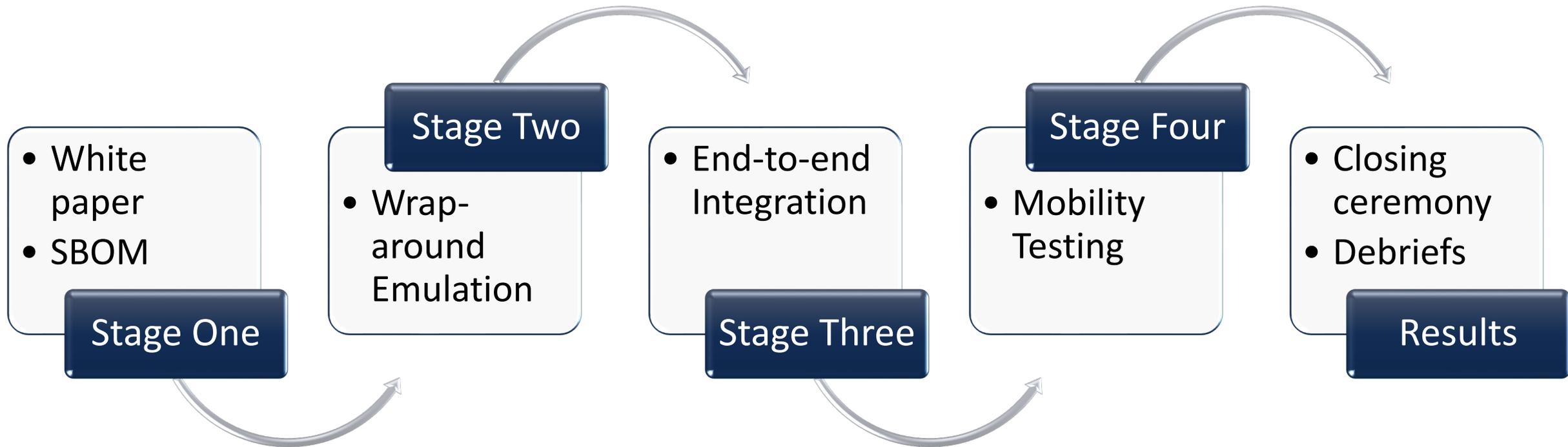


\*F1 integration must be successfully completed *before* submitting the CU+DU to the host lab

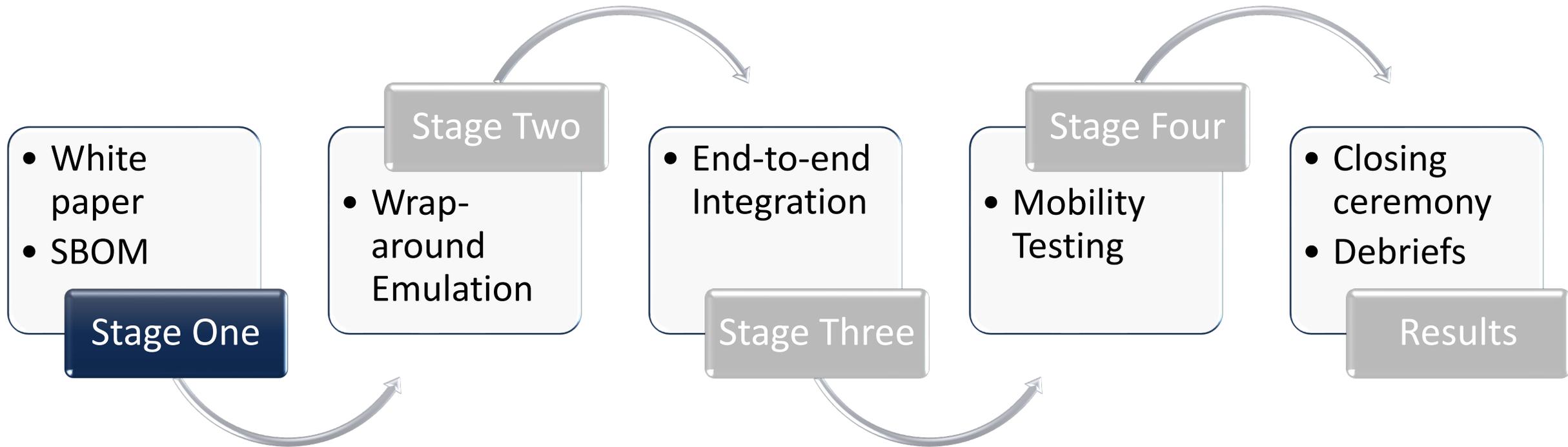
# Testing Tracks



# Stages



# Stage One



# Stage One



## Application (White Paper)

- ▶ Technical specifications
  - To schedule viable multi-vendor interoperability
- ▶ Mobility testing
  - [Optional] willing to participate
  - [Optional] specific gNB configuration
- ▶ Preferred 5G test system (Keysight or Viavi)
- ▶ Can submit multiple subsystems
- ▶ Application template and example
- ▶ White papers due March 1

## Selection

- ▶ Initial pool announced March 6
  - At least four CU+DU
  - At least four RU
- ▶ Criteria
  - Application score
  - Number of unique contestants
  - Enable testing tracks
  - Host lab resources
  - Market dominance



# Stage One



## Acceptance

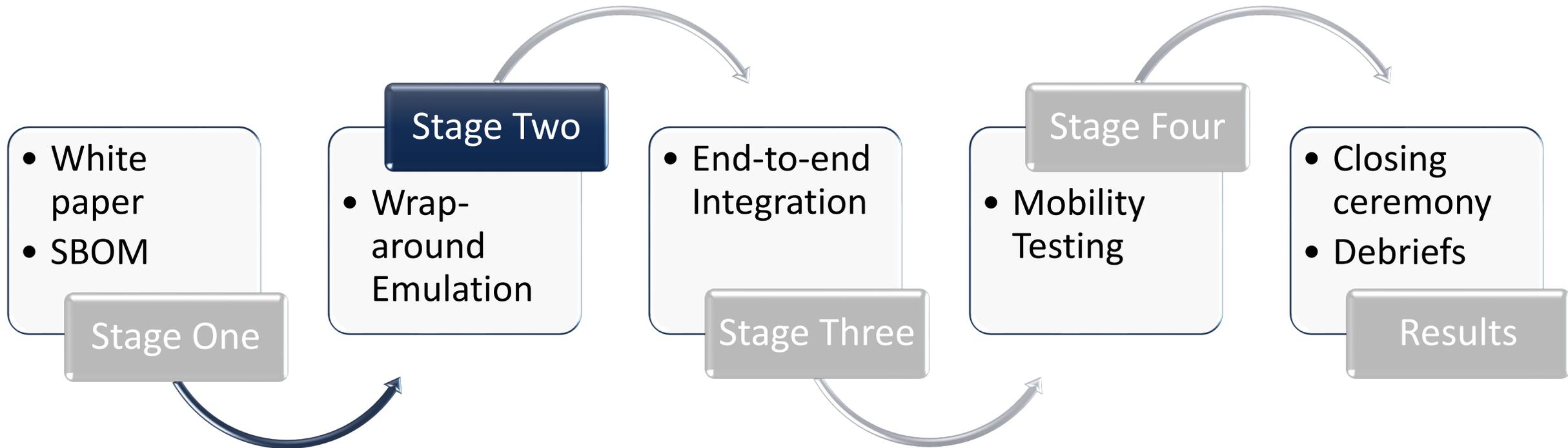
- ▶ For each subsystem accepted
  - 5G test system (Viavi or Keysight)
  - Track
  - Partners
  - Initial lab schedule
- ▶ Host lab onboarding
- ▶ Waitlist
- ▶ Walk-ons

## SBOM

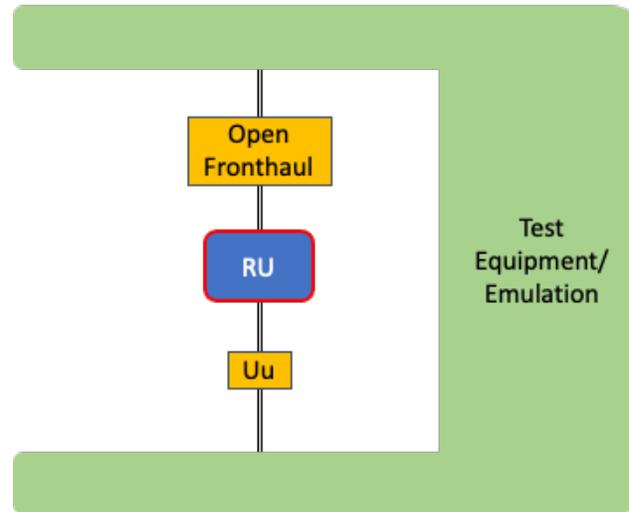
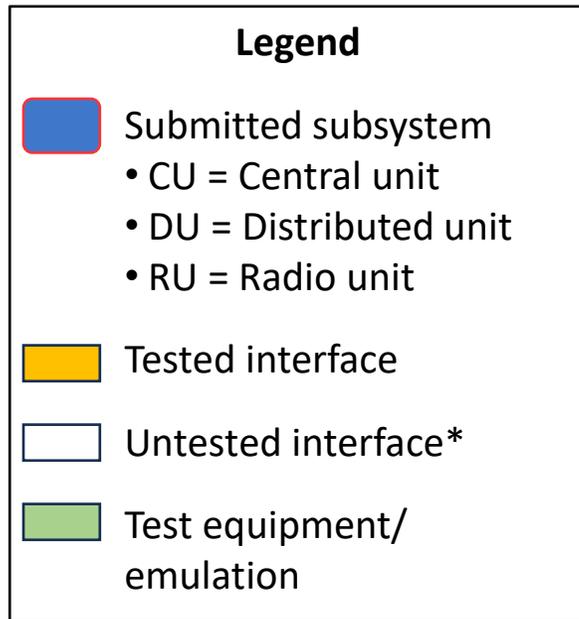
- ▶ Software Bill of Materials (SBOM)
- ▶ Vulnerability Exploitability eXchange (VEX)
  - If known vulnerabilities
- ▶ 2-weeks after acceptance



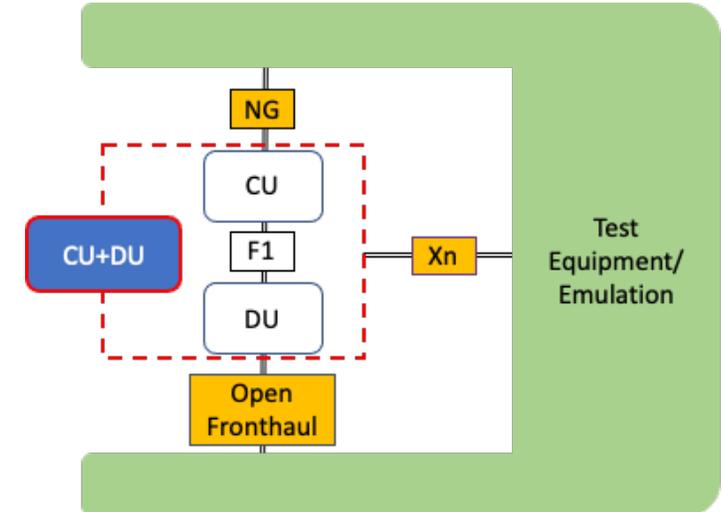
# Stages



# Wrap-around Emulation



RU



CU+DU

\*F1 integration must be successfully completed *before* submitting the CU+DU to the host lab

# Stage Two: Wrap-around Emulation Testing



## Overview

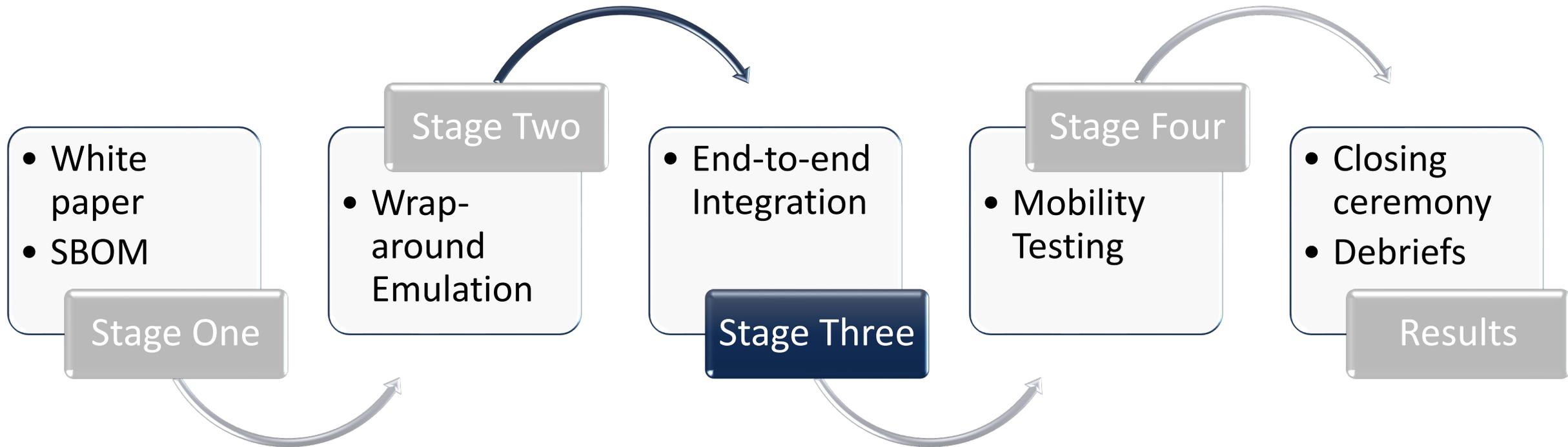
- ▶ Detailed Host Lab Test Plans
  - To be released March 20
- ▶ Delivery options
  - Cluster delivery
  - Remote install
  - Bare metal
- ▶ Lab testing ≈3 weeks

## Prizes

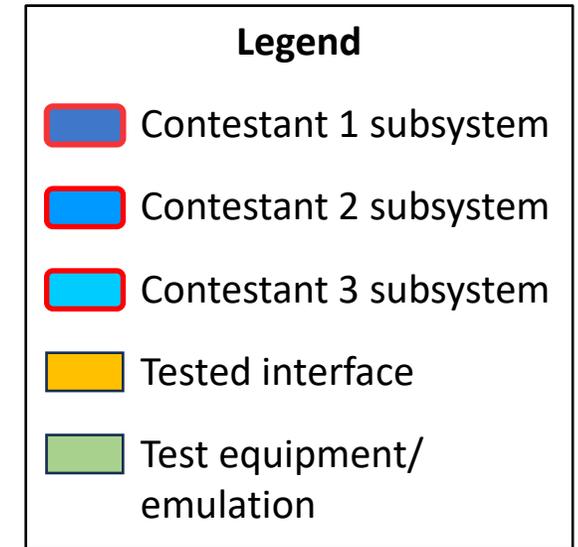
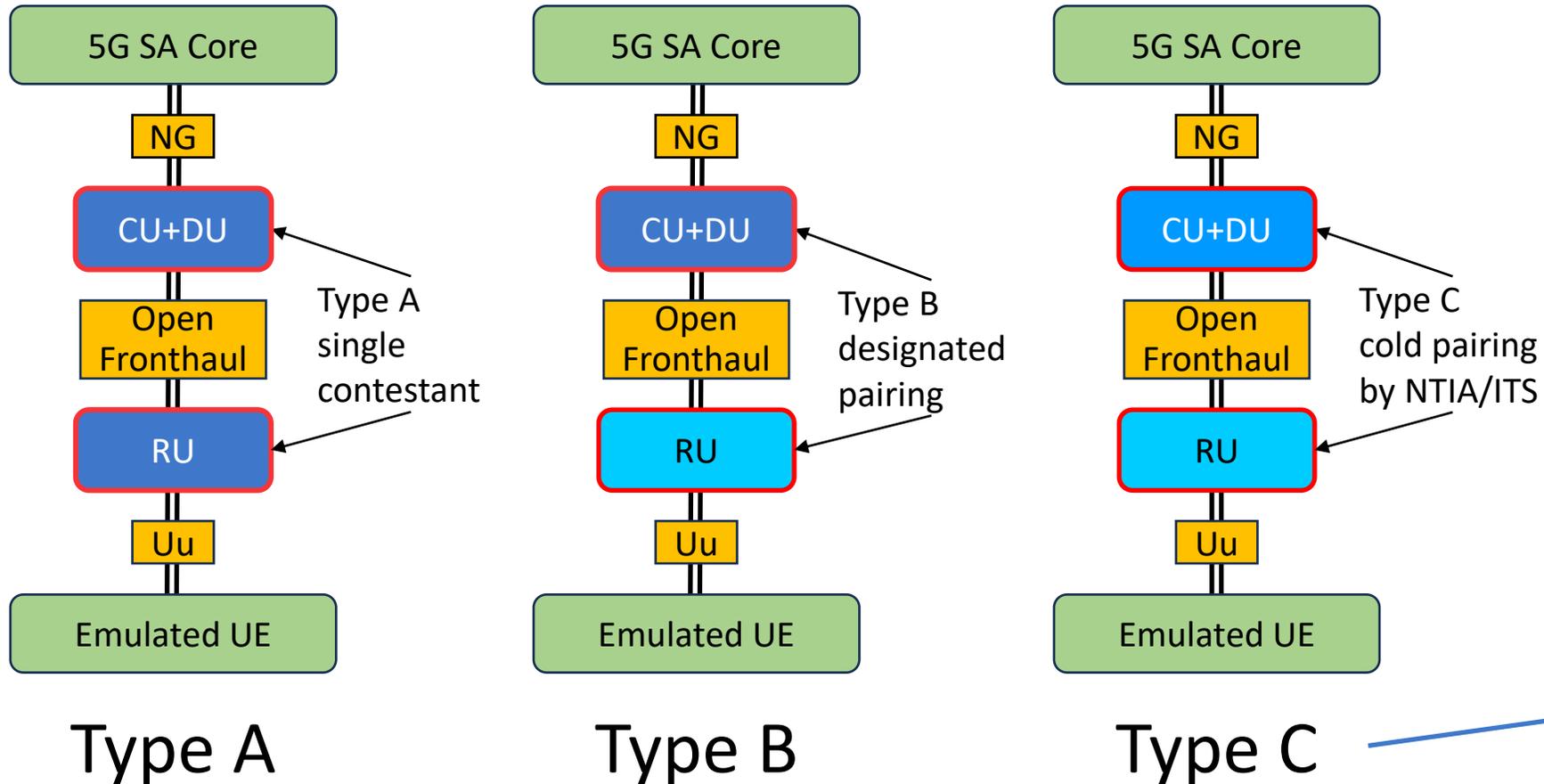
- ▶ First 10 contestants to pass Stage Two testing
- ▶ \$100,000 each prize



# Stages



# E2E Integration Testing



Only type C qualifies for Best Multi-vendor Integration Prizes

# Stage Three: E2E Integration Testing

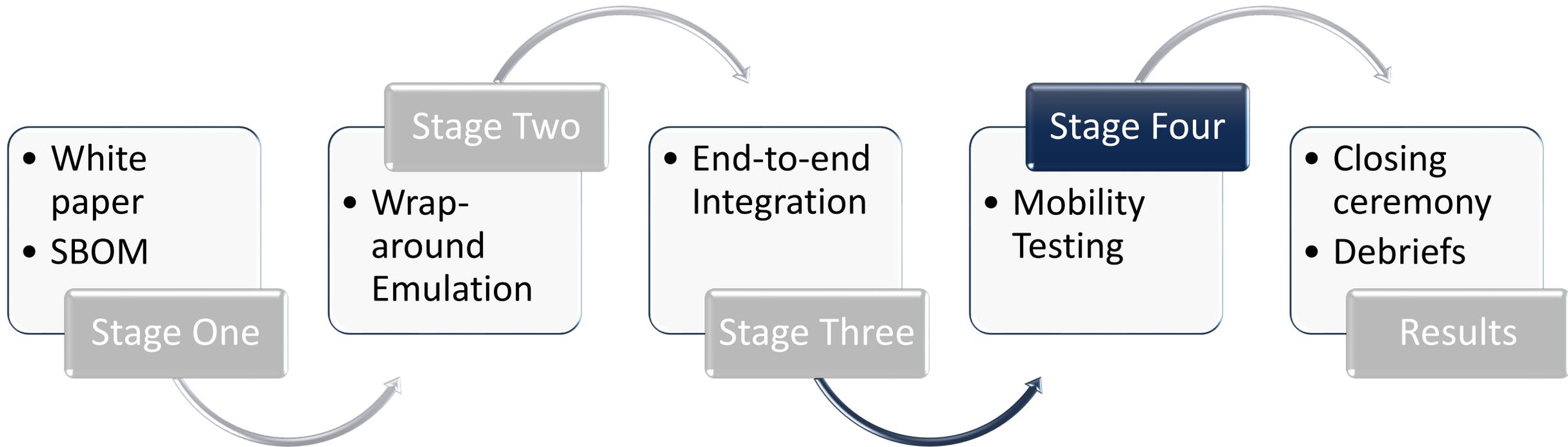


- ▶ End-to-end integration
  - CU+DU and RU
  - Mandatory and optional lab testing
  - Only Type C qualify for Best Multi-vendor Integration Prizes
- ▶ Lab testing ≈3 to 6 weeks
- ▶ Best Multi-vendor Integration Prizes
  - Four prizes
  - Only Type C

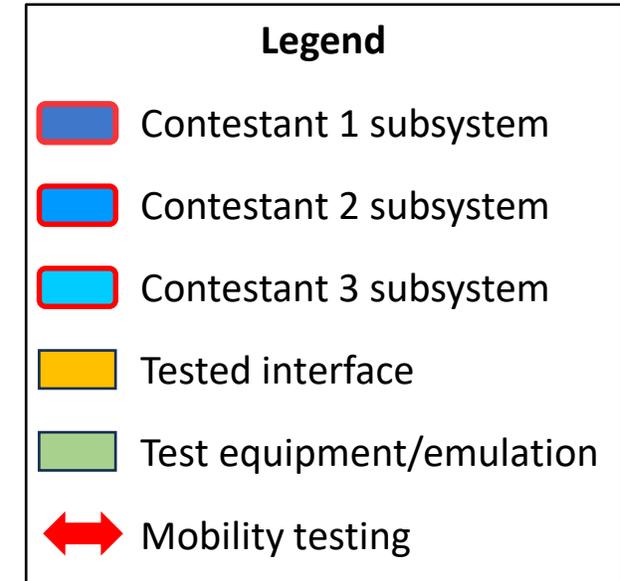
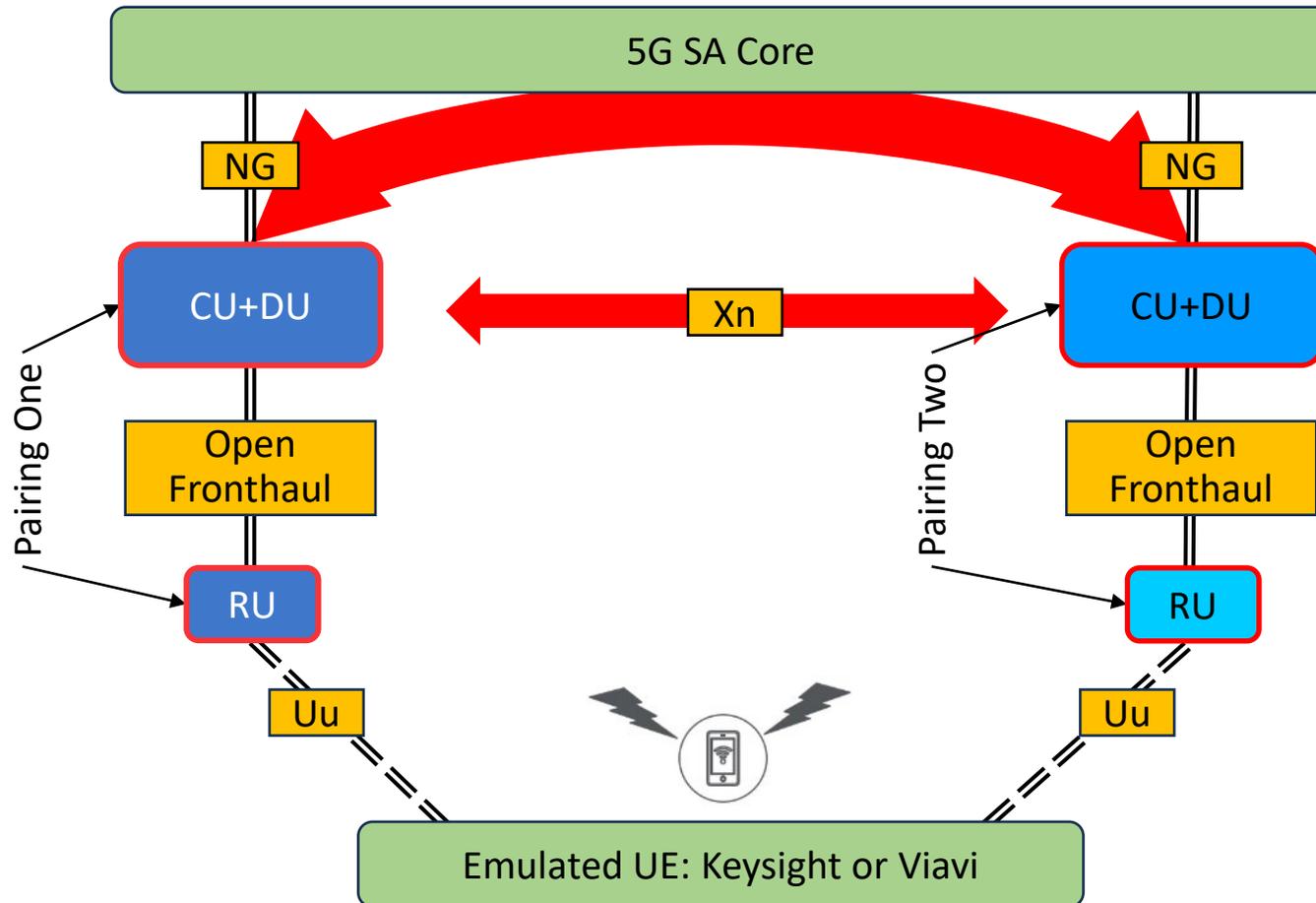
	CU+DU	RU	Criteria
1 <sup>st</sup> Prize	\$750,000 and lab time	\$750,000 and lab time	Highest score
2 <sup>nd</sup> Prize	\$250,000	\$250,000	2 <sup>nd</sup> highest score



# Stages



# Mobility Testing



# Stage Four: Mobility Testing

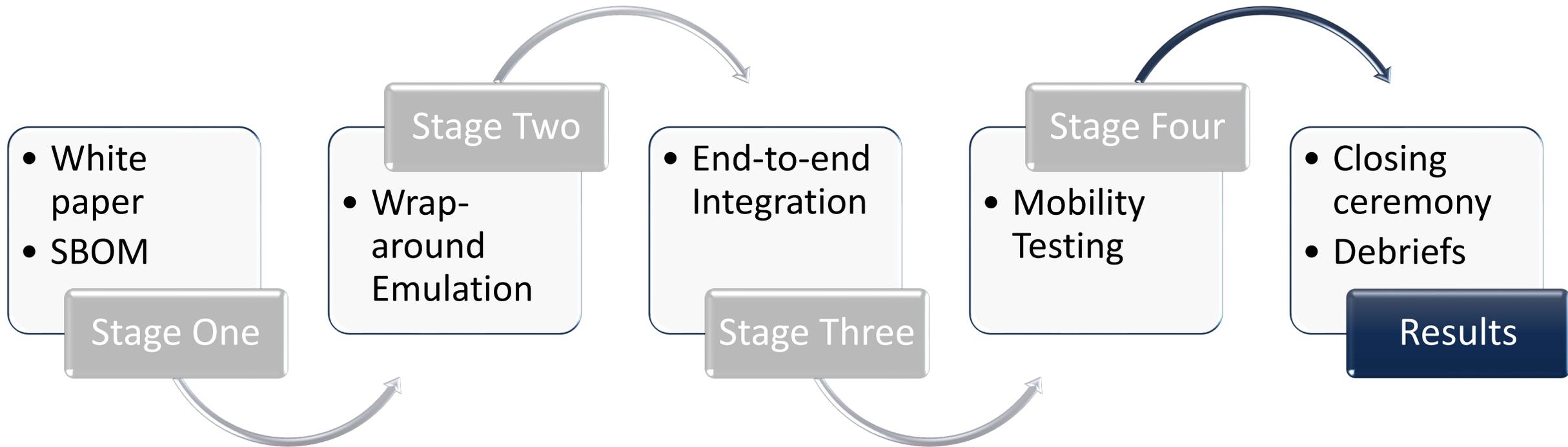


- ▶ Mobility testing
  - Two pairs (CU+DU and RU) from Stage Three
- ▶ Any two pairing types
  - Type A, single contestant
  - Type B, designated pairing
  - Type C, cold pairing
- ▶ Lab testing ≈6 weeks
- ▶ Best Mobility Prize
  - Group award
  - Criteria: highest mobility test score
  - \$3,000,000 divided among contestants

Number of Contestants in Mobility Group	Prize Per Contestant	5G Session Configuration
If Two (2)	\$1,500,000	Type A and Type A
If Three (3)	\$1,000,000	Type A and Type B/C
If Four (4)	\$750,000	Type B/C and Type B/C



# Stages



The CableLabs logo is rendered in a large, white, sans-serif font. The 'C' is significantly larger than the other letters. A registered trademark symbol (®) is positioned to the upper right of the 's'. The background is a dark, blue-toned city skyline at night, with lights reflecting on a body of water in the foreground. A solid red vertical bar is located on the far left edge of the slide.

# CableLabs<sup>®</sup>

**2023 5G Challenge Webinar –  
Host Lab Overview**

**CableLabs**

Mark Poletti | Director Mobile Networks

[m.poletti@cablelabs.com](mailto:m.poletti@cablelabs.com)



## CableLabs/Kyrio Host Lab

As a leading innovation and R&D lab, CableLabs creates global impact through its member companies around the world.

With a state-of-the-art research facility and collaborative ecosystem with thousands of vendors, CableLabs delivers impactful network technologies for the entire industry.

During the 5G Challenge the host lab will:

- Provide onboarding information to all contestants
- Provide access to the test environment and expert staff with a commitment to provide timely support to contestants during testing
- Conduct testing according to the test specifications, support troubleshooting, and provide results to NTIA/ITS
- Coordinate project schedules, logistics, and other support

# Subsystem Delivery options

## **Delivery Option One: Cluster delivery and local host lab installation**

Contestant subsystem hardware/software servers are staged, pre-tested, and pre-configured, and delivered to host lab for integration and testing.

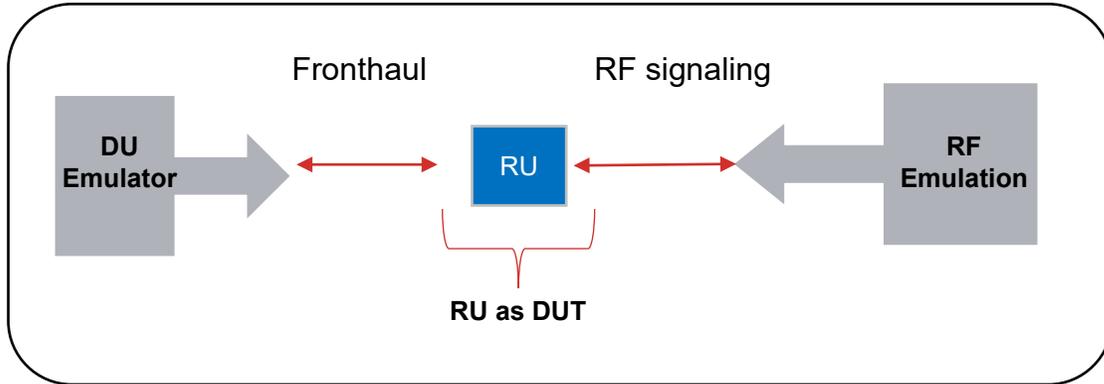
## **Delivery Option Two: Remote install onto host lab OpenShift CaaS/PaaS cluster**

Delivery of contestant subsystem is remotely uploaded and installed into host lab cluster for integration and test.

## **Delivery Option Three: Remote install onto host lab “bare metal” system.**

Contestant will be provided remote access to install their desired operating system and, subsequently, upload and install their subsystem software on the host lab hardware for integration and testing.

# Stage Two - RU Test Configuration



RU Wraparound tester consists of:

- DU emulator (CUSM-plane emulator)
- RF signal analyzer/RF signal generator
- PTP source

Open RAN test equipment vendors:

- Viavi and Keysight

*Stage Two RU test will include the following test categories:*

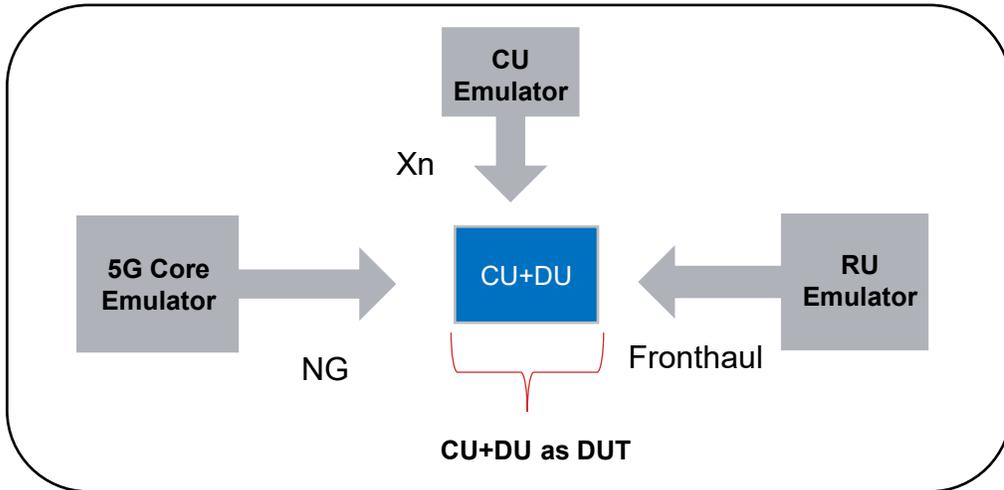
## **Integration**

The objective is for the RU to demonstrate successful integration into the test environment

## **Conformance**

The objective is for the RU to perform O-RAN Work Group (WG) 4 conformance and basic functionality tests. It also includes essential M-Plane procedures and S-Plane functionality that are required for the integration with the CU+DU combo in Stage-3.

# Stage Two - CU+DU Test Configuration



CU+DU wraparound tester consists of:

- NG (N2/N3) interface towards 5G SA core emulator
- Fronthaul interface towards RU emulator
- Xn interface towards CU emulator

Open RAN test equipment vendors:

- Viavi and Keysight

*Stage Two CU+DU test will include the following test categories:*

## **Integration –**

The objective is for the CU+DU to demonstrate successful integration into the test environment

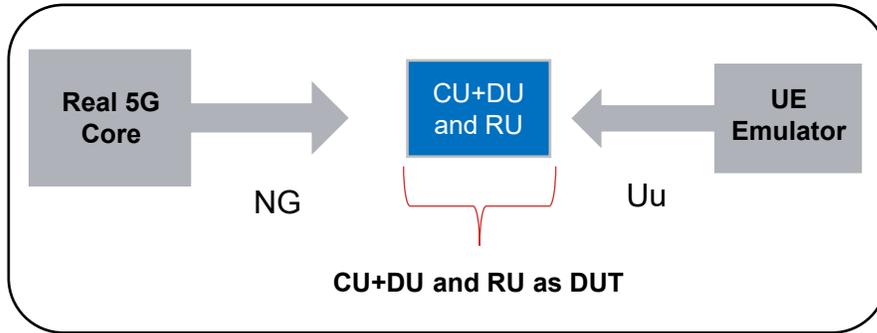
## **Functionality –**

The objective is for the CU+DU to perform O-RAN Alliance conformance and basic functionality tests. It also includes essential M-Plane procedures and S-Plane functionality that are required for interoperability tests.

## **Interoperability**

The objective is to demonstrate CU+DU fronthaul interoperability between the contestant's DU and a reference RU, using Radio Layer and Core Network interfaces emulation. This also includes mobility with Xn handover messaging across the CU plane with a CU emulator.

# Stage Three - E2E Test Configuration



## CU+DU and RU test configuration consists of:

- Real 5G SA core
- UE emulator

## Open RAN test equipment vendors:

- Viavi and Keysight

*Stage Three CU+DU and RU E2E test will include the following test categories:*

### **Integration**

Objective is to verify the basic connectivity of the end-to-end setup which are prerequisite for running any further functional, performance and stress test cases. The test cases validate the ability of contestant individual subsystems (CU+DU and RU) to successfully integrate with the E2E setup which consists of a UE emulator, non-emulated 5G SA core, and other contestants' subsystems (e.g., CU+DU, or RU).

### **Functional**

Objective is to verify the contestant subsystem's compliance to O-RAN Alliance and 3GPP specifications with regards to protocol conformance and baseline functionality to build a working setup of E2E 5G network for establishing a successful data session.

### **Performance**

Objective is to verify contestant (CU+DU and RU) subsystem performance (e.g. latency, jitter, and throughput) for different traffic types (i.e. TPC, UDP, RTP, etc.) for optimal RF and sub-optimal conditions for a single UE.

### **Stress, Reliability, Stability**

Objective is to verify contestant (CU+DU and RU) subsystem performance (e.g., latency, jitter, and throughput) for different traffic types (i.e. TPC, UDP, RTP, etc.), reliability and stability conditions using pre-defined traffic models for multiple UEs at varying RF conditions.

# Stage Four – Mobility Test Case Overview

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*Stage Four Mobility test will include the following test categories:*

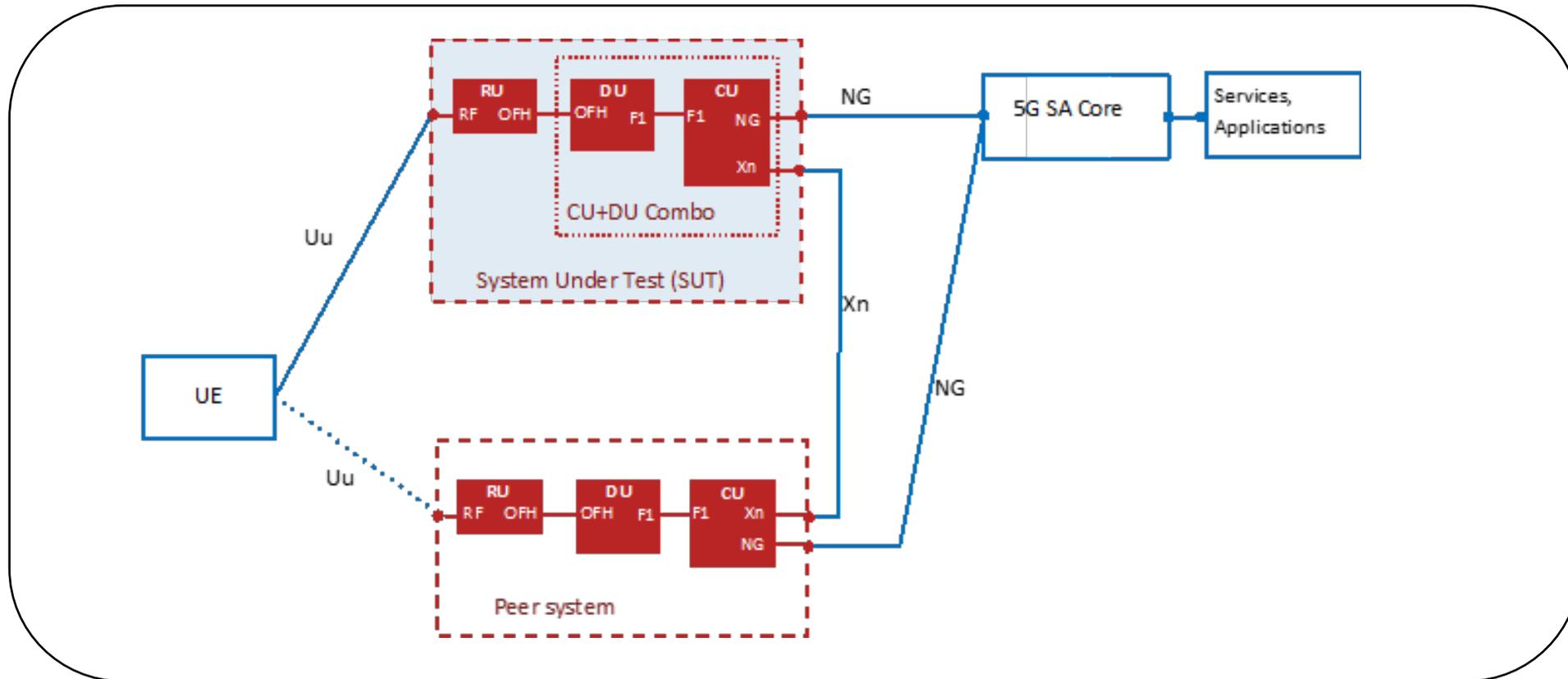
## **Integration**

The objective is to integrate two standalone contestant subsystems (CU+DU and RU) and demonstrate successful integration into the test environment in preparation for mobility handover

## **Mobility**

The objective is for two standalone contestant subsystems (CU+DU and RU) to perform mobility tests that include connected mode handovers and idle mode mobility (NG, inter-CU)

# Stage Four – Mobility Configurations for Test



Inter-gNB, inter-CU mobility test environment



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**Thank You!**

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# \$7,000,000 Purse of Cash and In-kind Prizes



- ▶ Wrap-around Emulation Testing Prizes
  - \$1,000,000 purse
- ▶ Multi-vendor E2E Integration Prizes
  - \$2,000,000 purse
- ▶ Best Mobility Testing Prizes
  - \$3,000,000 purse
- ▶ Alternate prize structure
  - If mobility testing fails
- ▶ Best SBOM
  - Two prizes
  - \$100,000 and two weeks of security testing
- ▶ Best Collaborator
  - \$20,000 and two weeks of security testing



# Testing Track Schedules



## ► Wrap-around Emulation

Stage	Task	Est. Duration
<b>Two</b>	Wrap-around emulation of CU+DU <sub>1</sub> or Wrap-around emulation of RU <sub>2</sub>	3 weeks
<b>Total</b>		<b>3 weeks</b>

## ► Multi-vendor E2E Integration (only Type C)

Stage	Task	Est. Duration
<b>Two</b>	Wrap-around emulation of CU+DU <sub>1</sub> Wrap-around emulation of RU <sub>2</sub>	3 weeks (in parallel)
<b>Three</b>	E2E integration of (CU+DU <sub>1</sub> and RU <sub>2</sub> ) Must be Type C	6 weeks
<b>Total</b>		<b>9 weeks</b>

## ► Mobility

Stage	Task	Est. Duration
<b>Two</b>	Wrap-around emulation of CU+DU <sub>1</sub> Wrap-around emulation of RU <sub>2</sub>	3 weeks (in parallel)
<b>Two</b>	Wrap-around emulation of CU+DU <sub>3</sub> Wrap-around emulation of RU <sub>4</sub>	3 weeks (in parallel)
<b>Three</b>	E2E integration of (CU+DU <sub>1</sub> and RU <sub>2</sub> )	3 to 6 weeks
<b>Three</b>	E2E integration of (CU+DU <sub>3</sub> and RU <sub>4</sub> )	3 to 6 weeks
<b>Four</b>	Mobility testing between (CU+DU <sub>1</sub> and RU <sub>2</sub> ) and (CU+DU <sub>3</sub> and RU <sub>4</sub> )	6 weeks
<b>Total</b>		<b>18 to 24 weeks</b>



# Publication Policy



## Information Published Externally

- ▶ Winners and their subsystems
- ▶ Discretion of 5G Challenge organizers
  - Contestant names, subsystems, testing tracks, integration partners, E2E integration type
  - Test results
  - Lessons learned
- ▶ Anonymized summaries
  - White paper evaluation, acceptance
  - SBOM and VEX
  - Contestant debriefs
- ▶ Closing ceremony

## Internal Use Only

- ▶ White paper applications not accepted
- ▶ SBOM details
- ▶ VEX details
- ▶ Details if contestant
  - Withdraws
  - Disqualified
  - Fails to complete Stage Two



# 2023 5G Challenge: Important Dates



White papers due	March 1, 2023
Accepted contestants announced	March 6, 2023
SBOM and VEX submissions due	Two weeks after acceptance
Test plan details released	March 20, 2023
Lab testing	March 20, 2023–September 15, 2023
Updated SBOM and VEX due	September 15, 2023
Closing ceremony and final awards	September 21, 2023
Contestant debriefs	By October 12, 2023
Window for lab time and security prizes	October 9, 2023–March 29, 2024



# Web Resources

# SBOM and VEX

- ▶ [“Software Bill of Materials”](#) by NTIA
- ▶ [“How-To Guide for SBOM Generation”](#) by NTIA
- ▶ [“Survey of existing SBOM formats and standards”](#) by NTIA
- ▶ [“Vulnerability-Exploitability eXchange \(VEX\) – An Overview”](#) by NTIA
- ▶ [“Vulnerability Exploitability eXchange \(VEX\) – Use Cases”](#) by the Cybersecurity and Infrastructure Security Agency (CISA)
- ▶ Blog [“A deeper dive into VEX documents”](#) by Derek Kraszewski, Adolus

# 2023 5G Challenge Information



- ▶ 2023 5G Challenge website
  - <https://5gchallenge.ntia.gov/>
- ▶ Challenge.gov
  - <https://www.challenge.gov/?challenge=2023-5g-challenge>
- ▶ 2022 5G Challenge Showcase video
  - <https://www.youtube.com/watch?v=RAfw9IW6-FU>



# Questions